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Lin

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(54) **COLLAPSIBLE KEYBOARD**

(75) Inventor: **Winky Lin**, Taipei (TW)

(73) Assignee: **Silitek Corporation**, Taipei (TW)

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(52) **U.S. Cl.** **400/490**; 400/472; 400/495; 400/495.1; 400/491.2; 400/680; 400/681; 400/682

(58) **Field of Search** ..... ; 400/472, 490, 400/491.2, 495, 495.1, 680, 488, 489, 681, 682; B41J 5/12, 5/14, 5/16

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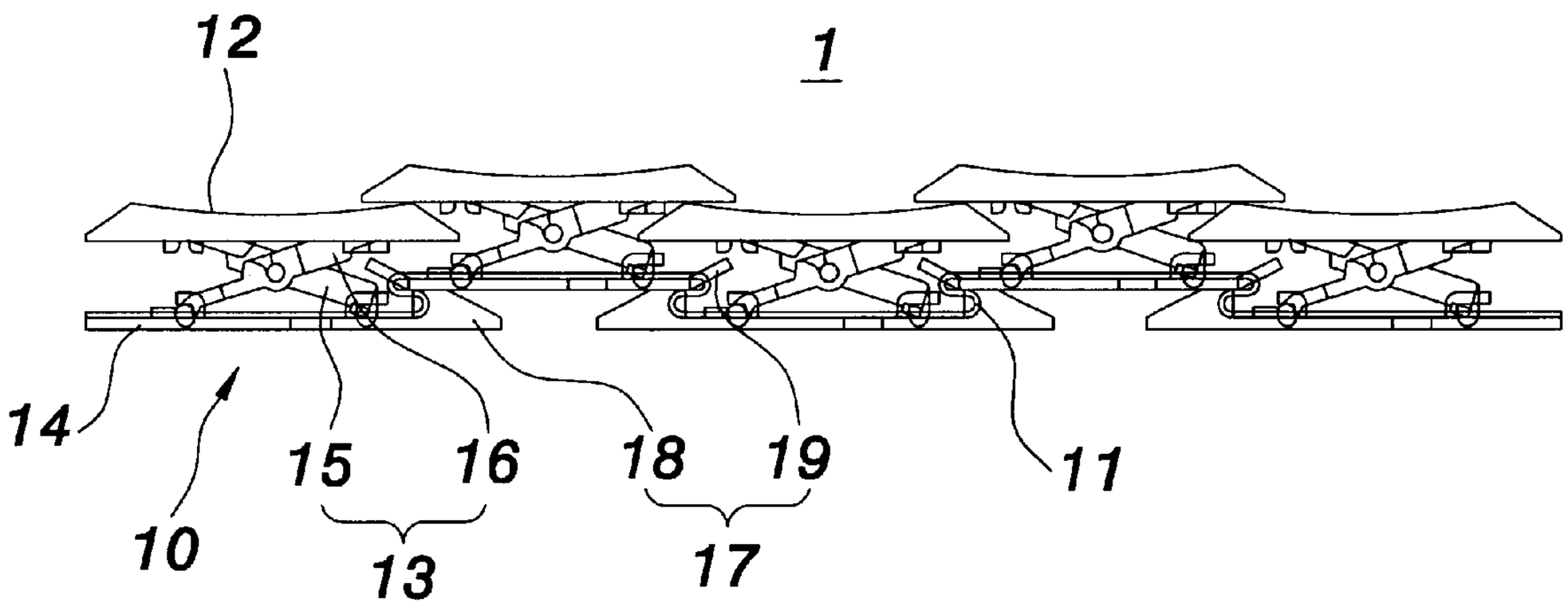
Primary Examiner—Andrew H. Hirshfeld
Assistant Examiner—Andrea Hence Evans
(74) *Attorney, Agent, or Firm*—Rabin & Berdo, P.C.

(57) **ABSTRACT**

A collapsible keyboard comprises at least one keyboard module, and each keyboard module has a plurality of keyswitches arranged in array pattern. At least one membrane circuit is provided to connect the plurality of keyswitches. When the keyboard is in an operation state, each keyswitch having a predetermined separation with adjacent keyswitch, and the separation is the same as that in a standard keyboard. To shrink the keyboard, the plurality of keyswitches can be arranged in a collapsed state to reduce the transverse size of the keyboard, the lengthwise size of the keyboard, or both sizes.

2 Claims, 8 Drawing Sheets



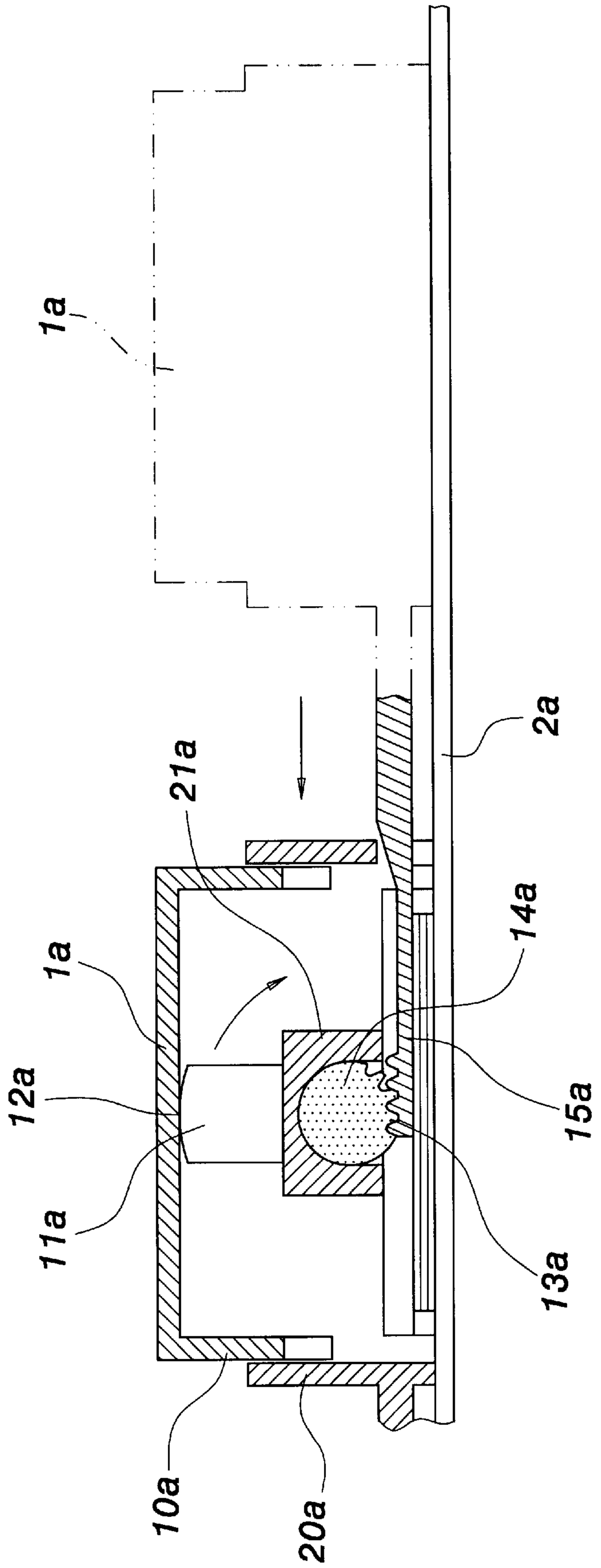


FIG. 1
PRIOR ART

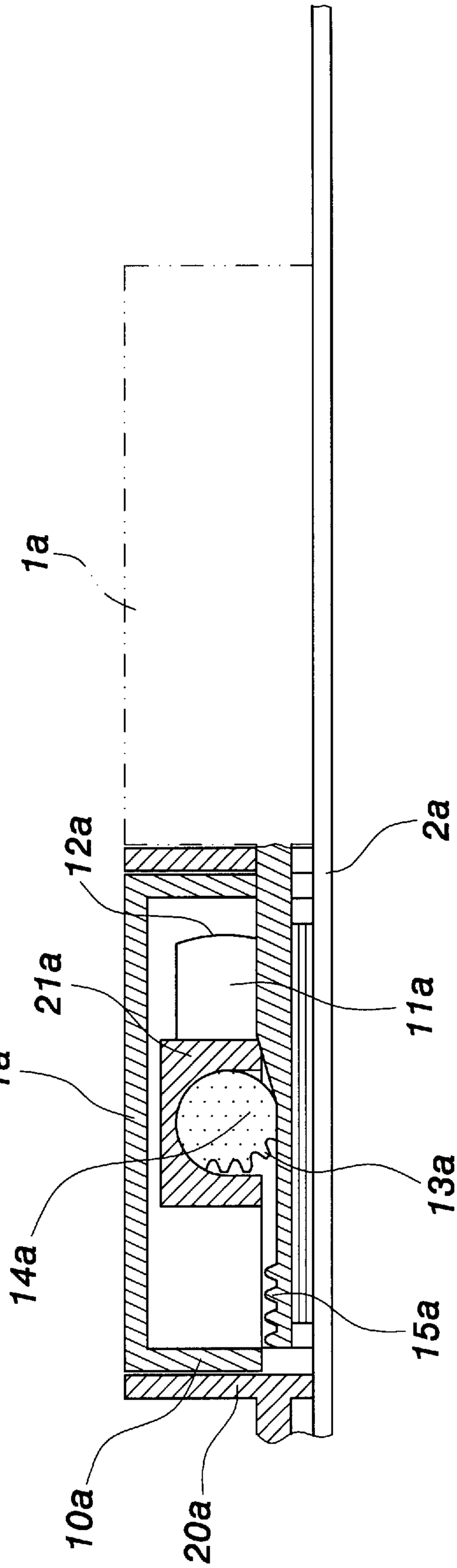


FIG. 2
PRIOR ART

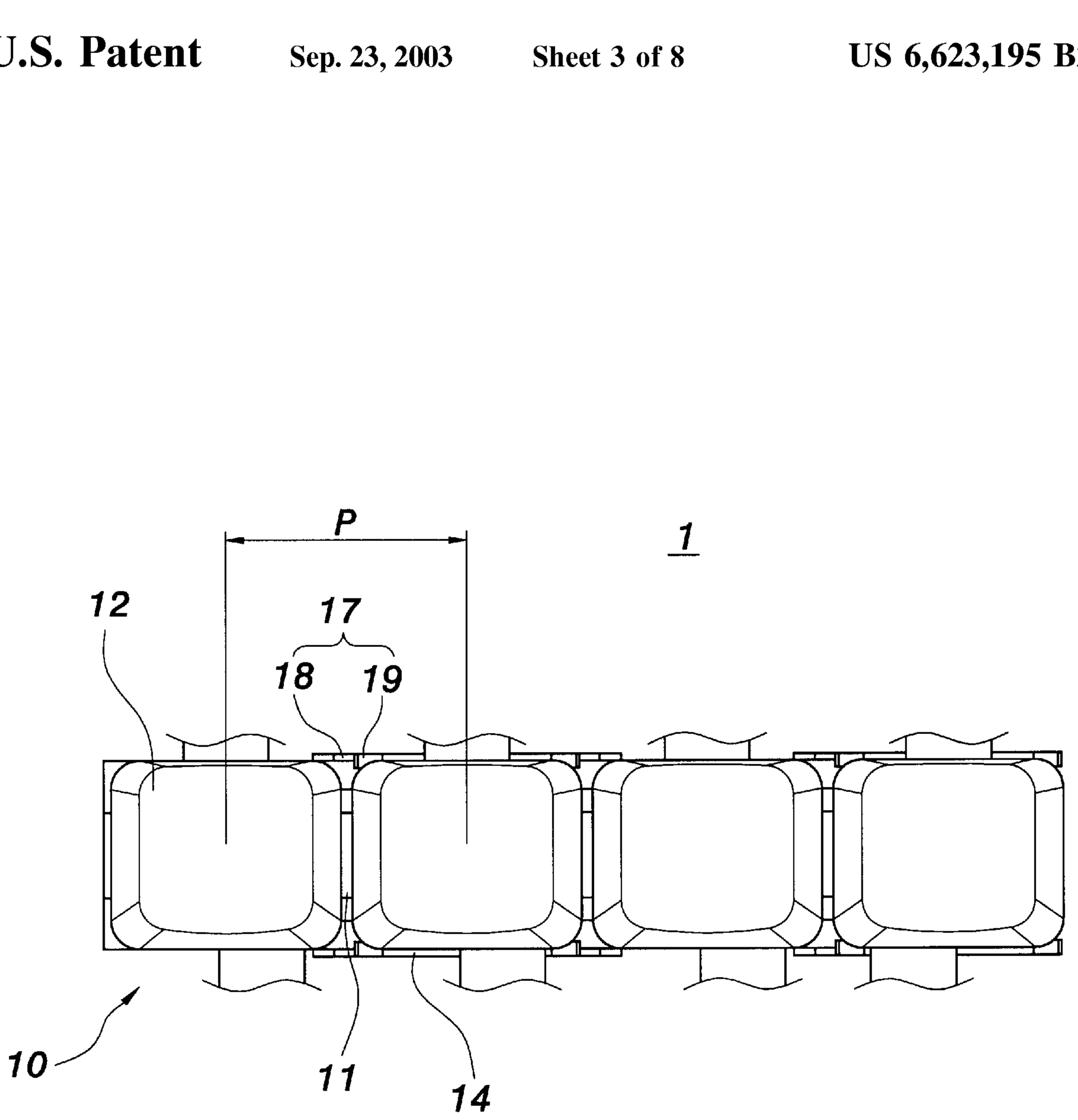


FIG.3

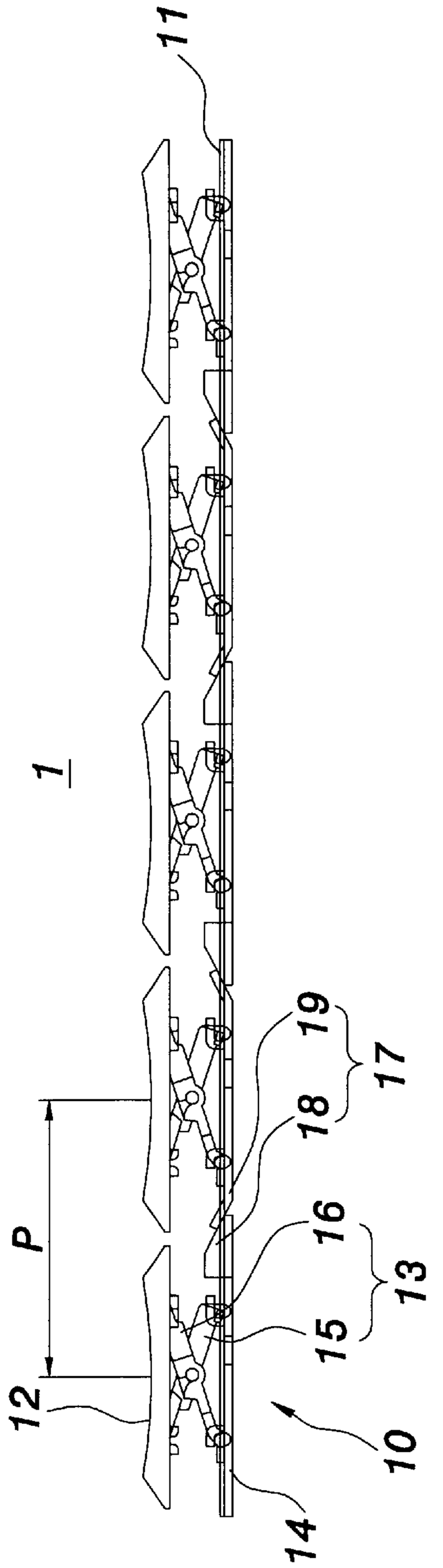


FIG. 4

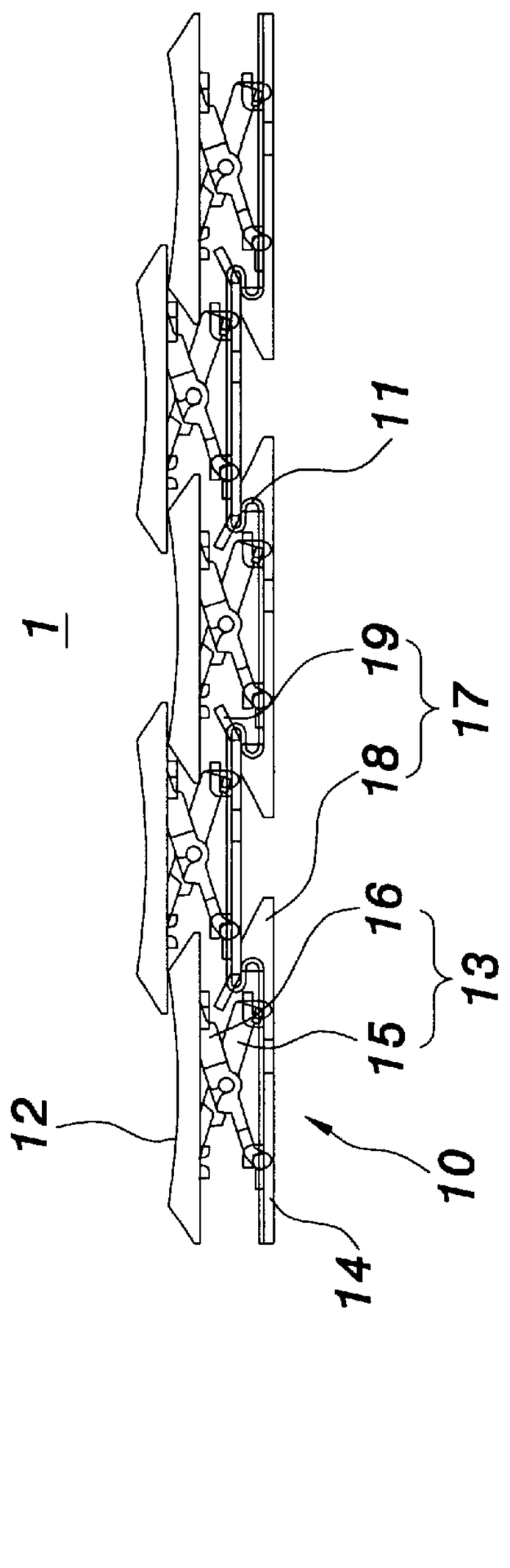


FIG. 5

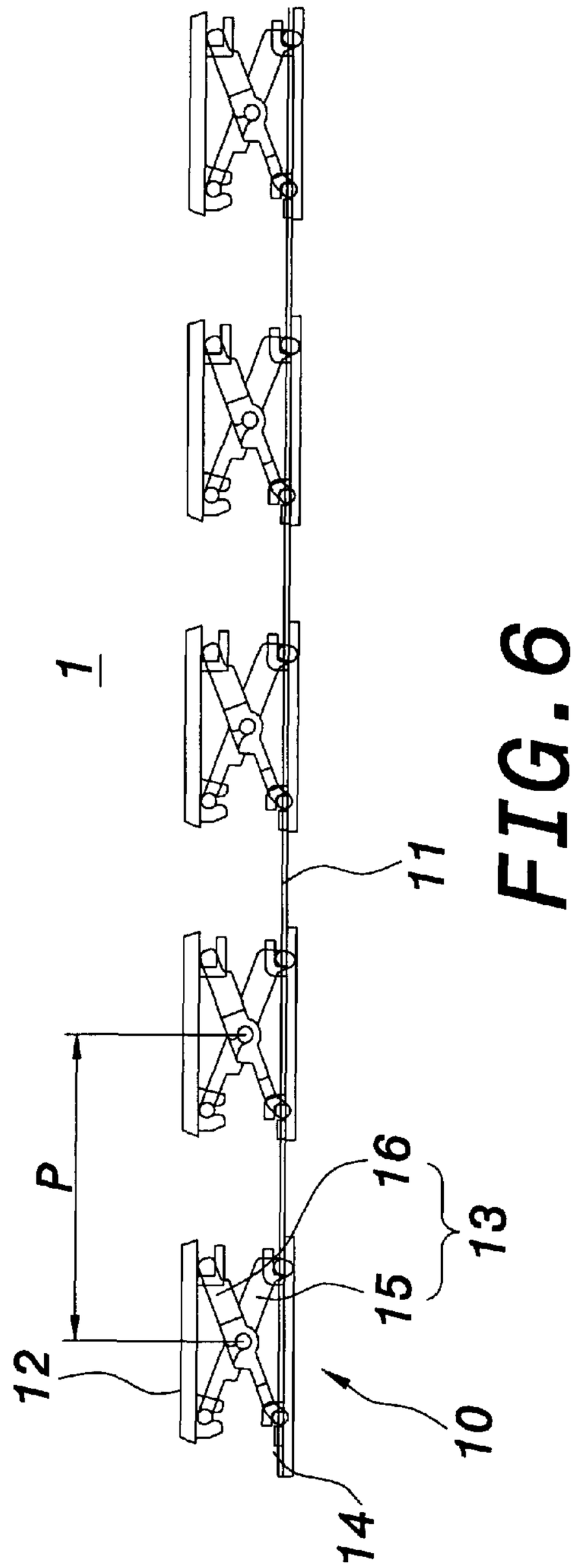


FIG. 6

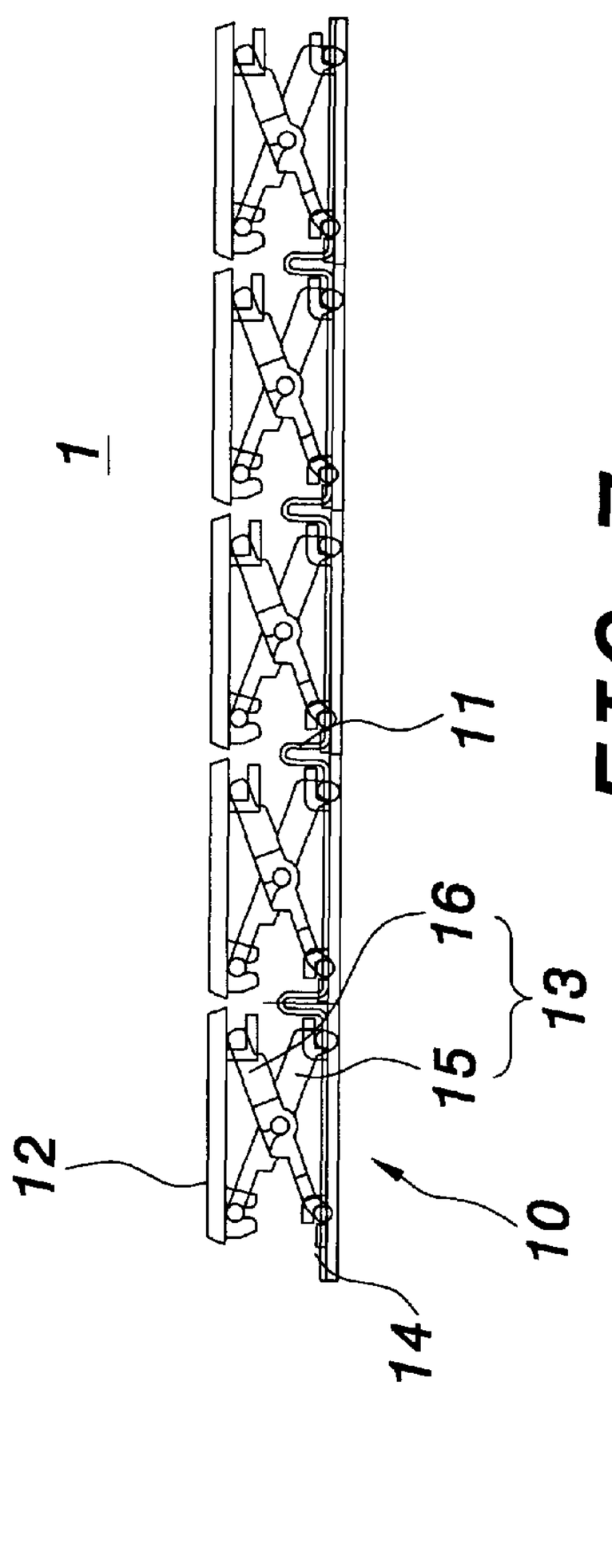


FIG. 7

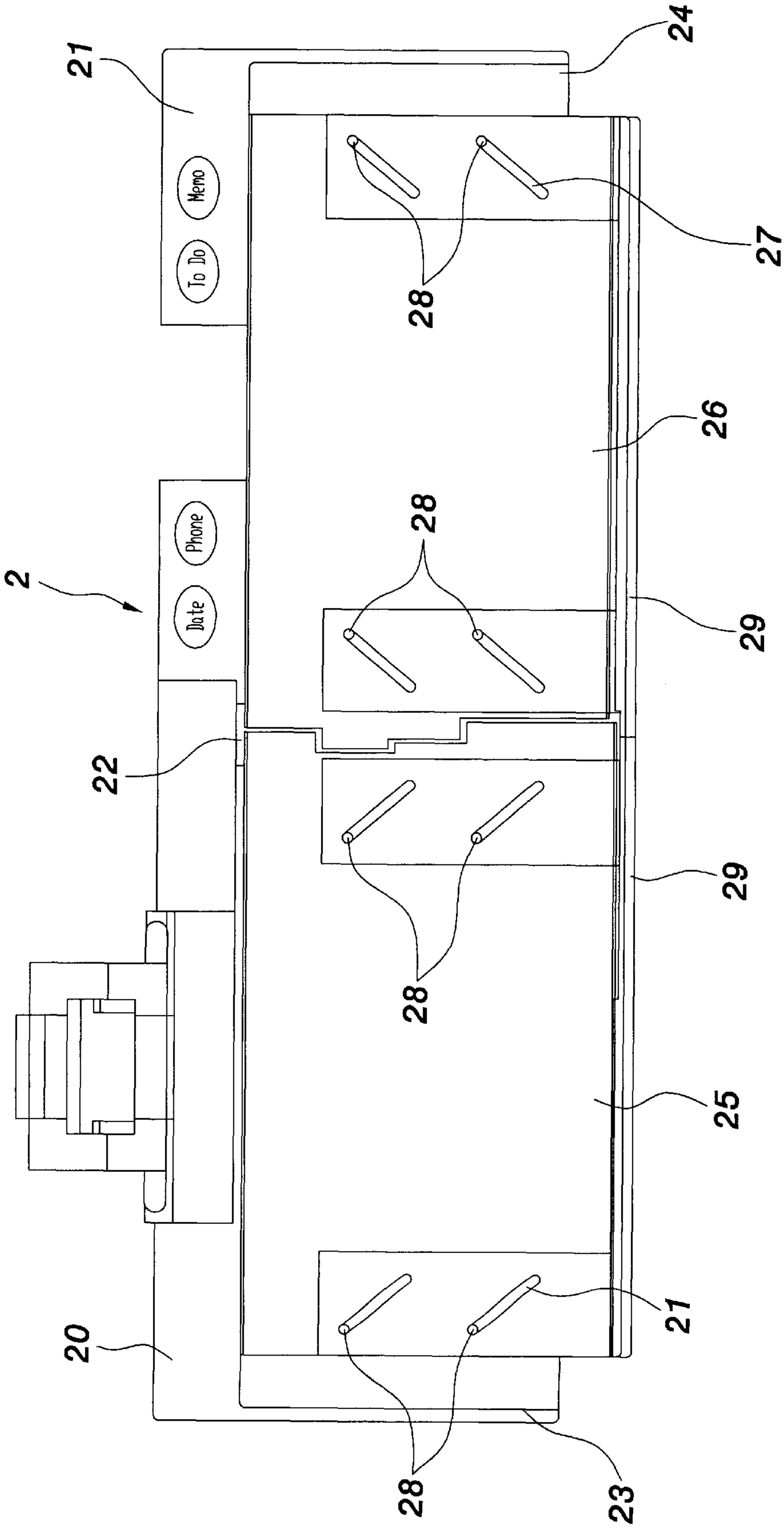


FIG. 8

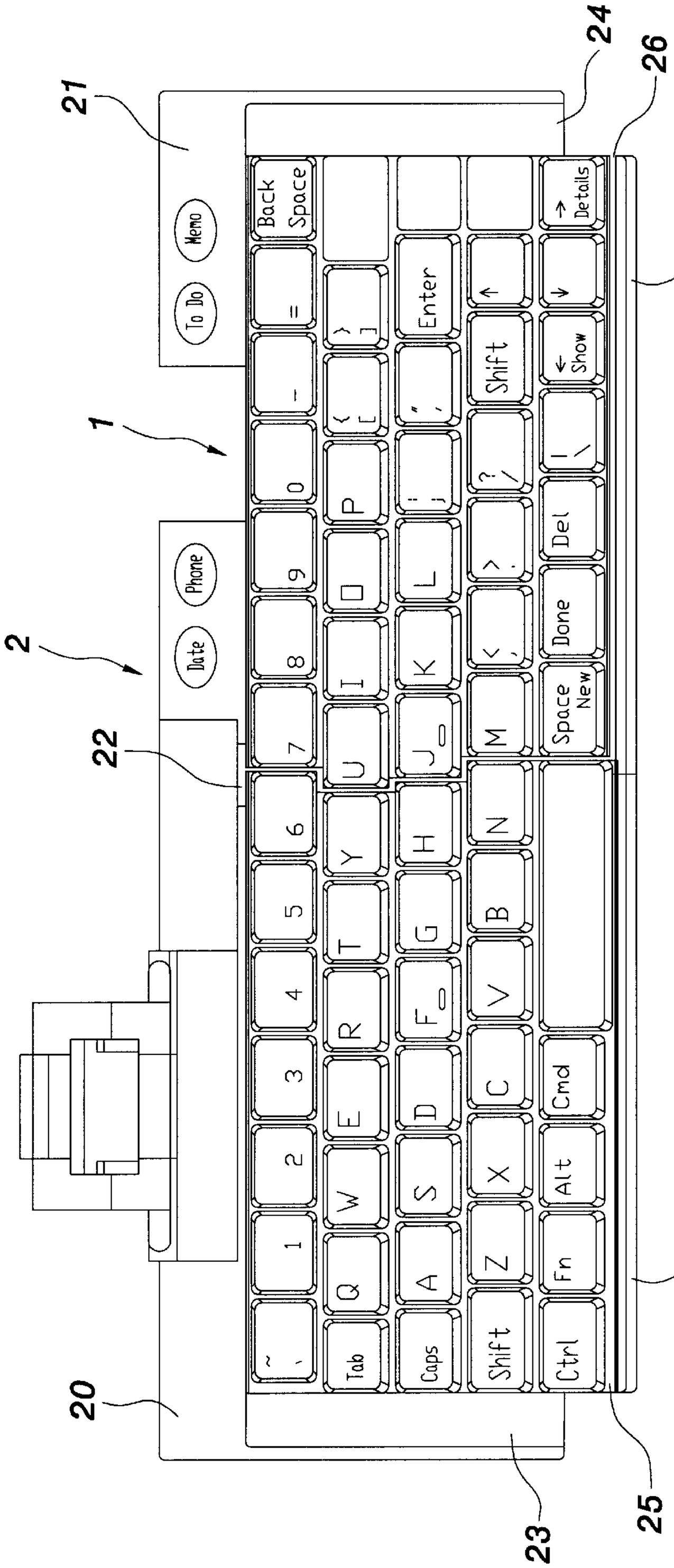

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FIG. 9

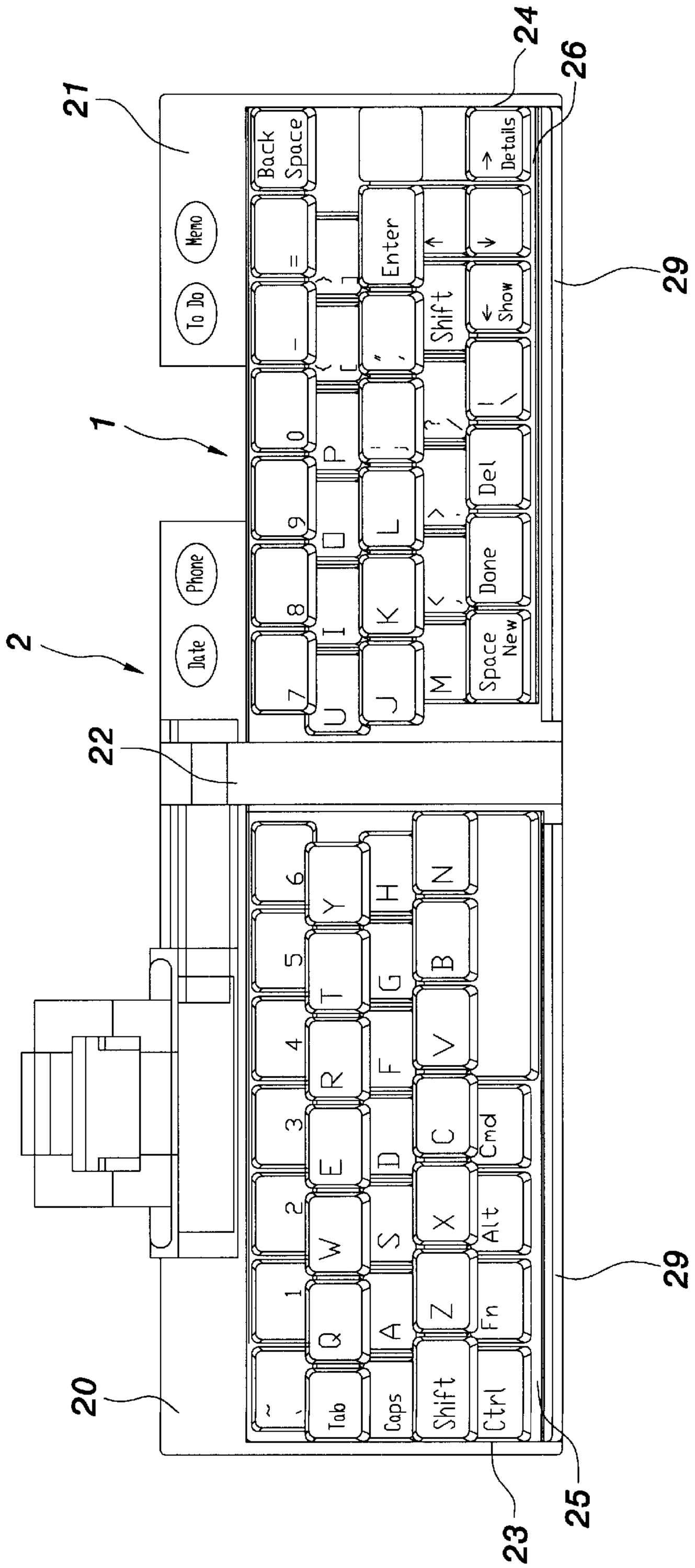
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FIG. 10

COLLAPSIBLE KEYBOARD

FIELD OF THE INVENTION

The present invention relates to a collapsible keyboard, especially to a collapsible key board for compact electronic devices such as a PDA (personal digital assistant).

BACKGROUND OF THE INVENTION

The current trend of electronic products is to provide portability for the user. Therefore, the PDA and cellular phones are prevailing, and user interfaces for the portable electronic products, such as keyboards, are also under extensive development.

The design goals of the keyboards for portable electronic products is compact size and preserving good ergonomics and function.

The size of the keyboard can be reduced by decreasing the size of each keyswitch on the keyboard. Alternatively, the separation between adjacent keyswitches can also be reduced for further decreasing the size of the keyboard. However, the keyboard with over crowded arrangement of keyswitches may cause frequent typewriting errors.

The foldable keyboard is another kind of keyboard for providing portability. However, the reduction in size still has limits.

FIG. **1** shows a prior art keyboard with variable volume. The keyboard has a plurality of keyswitches **1***a*. A sidewall **10***a* is arranged on a lateral side of one keyswitch **1***a* and attached to an inner surface of a supporting wall **20***a* of a base **2***a*, whereby the keyswitch **1***a* can be slid in a vertical direction. The keyswitch **1***a* further has a restoring spring ha with a bump **12***a* on a topside thereof. The bump **12***a* is in contact with a top inner surface of the keyswitch **1***a* to boost the keyswitch **1***a* for operation. The keyswitch **1***a* further has a cylindrical shaft **14***a* below the spring ha and having serrations **13**a on an outer circumference thereof. The cylindrical shaft **14***a* is pivotally arranged on a retaining case **21** a of the base **2***a*. Moreover, a driving plate **15***a* is engaged with the serrations **13***a* of the cylindrical shaft **14***a* and connected to another keyswitch **1***a*. To shrink the keyboard, the driving plate **15***a* is pushed by an adjacent keyswitch **1***a* and rotates the cylindrical shaft **14** through the serrations **13***a*. As shown in FIG. **2**, the bump **12***a* separates from the top inner surface of the keyswitch **1***a* and then the keyswitch **1***a* falls by the weight per se.

In the above-mentioned keyboard, the keyswitch **1***a* falls to reduce the volume of the keyboard. However, the keyswitch **1***a* should have sufficient height to accommodate the cylindrical shaft **14***a* and the driving plate **15***a*. The effect of volume reduction is limited.

Moreover, the keyswitch **1** has a complicated structure and the assembling thereof is cumbersome.

SUMMARY OF THE INVENTION

It is the object of the present invention to provide a collapsible keyboard with keyswitches having standard separation during operation and having reduced separation after operation.

To achieve the above object, the present invention provides a collapsible keyboard having at least one keyboard module. The keyboard module has a plurality of keyswitches arranged in an array pattern. At least one membrane circuit is provided to connect the plurality of keyswitches. When

the keyboard is in an operation state, each keyswitch has a predetermined separation with an adjacent keyswitch, and the separation is the same as that in a standard keyboard. To shrink the keyboard, the plurality of keyswitches can be arranged in a collapsed state to reduce the transverse size of the keyboard, the lengthwise size of the keyboard, or both sizes. The various objects and advantages of the present invention will be more readily separation is the same as that in a standard keyboard. To shrink the keyboard, the plurality of keyswitches can be arranged in a collapsed state to reduce the transverse size of the keyboard, the lengthwise size of the keyboard, or both sizes. The various objects and advantages of the present invention will be more readily understood from the following detailed description when read in conjunction with the appended drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a prior art keyboard with variable volume in an operation state;

FIG. **2** shows a prior art keyboard with variable volume in a shrunk state;

FIG. **3** shows a partial top view of the keyboard according to the present invention;

FIG. **4** shows a partial sectional view of the keyboard in an expanded state according to the present invention;

FIG. **5** shows a partial sectional view of the keyboard in a collapsed state according to the present invention;

FIG. **6** shows a partial sectional view of the keyboard in an expanded state according to another preferred embodiment of the present invention;

FIG. **7** shows a partial sectional view of the keyboard in a collapsed state according to another preferred embodiment of the present invention;

FIG. **8** is a top view showing the keyboard of the present invention with an outer cover;

FIG. **9** is a top view showing the outer cover in an expanded state; and

FIG. **10** is a top view showing the outer cover in a collapsed state.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **3** shows a partial top view of the keyboard according to the present invention, and FIG. **4** shows a partial sectional view of the keyboard according to the present invention. The present invention provides a collapsible keyboard with at least one keyboard module **1**. Each keyboard module **1** has a plurality of keyswitches **10** and a membrane circuit **11** connected to the keyswitches **10**.

Two adjacent keyswitches **10** have a separation P as shown in FIG. **3**. The separation P is similar to that in a standard keyboard (about 19 mm). Each keyswitch **10** comprises a key cap **12**, a lever assembly **13** and a base **14**.

The lever assembly **13** is of a scissors structure and comprises two pivotally arranged levers **15** and **16**. The top ends of levers **15** and **16** link to the bottom of the key cap **12**, and the bottom ends thereof link to the top of the base **14**. When the key cap **12** is pressed, the levers **15** and **16** sink into the key cap **12** to reduce the height of the keyswitch **10**.

Moreover, a slidable structure **17** is provided between the bases **14** of two adjacent keyswitches **10**. The slidable structure **17** is composed of a sliding surface **18** and a sliding plate **19**. The sliding surface **18** and the sliding plate **19** are arranged atop the bases **14**. The sliding plate **19** is slidable

atop the sliding surface **18** or below the sliding surface **18**. As shown in FIG. **5**, to collapse the keyboard, the keyswitches **10** are collapsed toward each other with the separation P being reduced. Moreover, the membrane circuit **11** is also advantageously deformed in response to the reduction in transverse or longitudinal length of the keyboard, as shown in FIG. **10**. Therefore, the keyboard is collapsed to have a compact size for portability.

FIG. **6** shows a partial sectional view of the keyboard in an expanded state according to another preferred embodiment of the present invention, and FIG. **7** shows a partial sectional view of the keyboard in a collapsed state according to another preferred embodiment of the present invention. Two adjacent keyswitches **10** have a separation P similar to that in a standard keyboard. The sizes of the key cap **12** and the base **14** are reduced, while the key cap **12** still has sufficient size for smooth operation. Therefore, the user won't type an error due to a reduction in the separation R To collapse the keyboard, the membrane circuit **11** is deformed and adjacent keyswitches abut to each other. Therefore, the keyboard in this preferred embodiment does not require a slidable structure provided between the bases **14** of two adjacent keyswitches **10**. The lever assembly **13** also facilitates to reduce the height of the keyboard.

As shown in FIG. **8**, an outer cover **2** is provided to the keyboard of the invention. The outer cover **2** is composed of two covering plates **20** and **21** pivotally connected through a pivotal plate **22**.

More particularly, one side of the pivotal plate **22** is pivotally connected to one lateral side of one of the covering plates **20**, and another side of the pivotal plate is pivotally connected to one lateral side of the other covering plate **21**. Therefore, the two covering plates **20** and **21** are assembled integrally through the pivotal plate **22**.

The two covering plates **20** and **21** have an accommodating space **23** and **24**, respectively. The accommodating spaces **23** and **24** receive two movable plates **25** and **26**, respectively. Each of the two movable plates **25** and **26** has a slanting slot **27**, and each of the accommodating spaces **23** and **24** has a guiding pin **28** slidably fit in the slanting slot **27**. Therefore, the movable plates **25** and **26** can be moved in an up and down direction as the slanting slot **27** slides with respect to the guiding pin **28**.

More particularly, each of the two movable plates **25** and **26** has a fixed side **29** on an outer lateral side thereof. The fixed side **29** is used to facilitate the movement of the movable plates **25** and **26** and the assembling of the keyboard module **1**.

As shown in FIGS. **9** and **10**, the keyboard modules **1** are arranged on the two movable plates **25** and **26**. The fixed side **29** is operated to move the movable plates **25** and **26** upward. The keyswitches **10** of the keyboard modules **1** are collapsed and received in the accommodating spaces **23** and **24**, respectively. It is easier for the user to fold the outer cover **2**.

Moreover, the keyboard modules **1** are staggered to each other when the outer cover **2** is folded. Therefore, each keyswitch **10** is positioned within an indentation formed by the plurality of keyswitches **10** to reduce the resultant thickness of keyboard after the outer cover **2** is folded.

Although the present invention has been described with reference to the preferred embodiment thereof, it will be understood that the invention is not limited to the details thereof. Various substitutions and modifications have suggested in the foregoing description, and other will occur to those of ordinary skill in the art. Therefore, all such substitutions and modifications are intended to be embraced within the scope of the invention as defined in the appended claims.

I claim:

1. A collapsible keyboard, comprising:

at least one keyboard module, having:

at least a first and a second adjacent keyswitch arranged in an array pattern, the first keyswitch having a predetermined separation with the adjacent second keyswitch, each keyswitch having a base, with the base of the first keyswitch having a sliding surface thereon, and the base of the second keyswitch having a sliding plate thereon, the first keyswitch and the second keyswitch being positionable in an expanded state where the respective keyswitches have the predetermined separation and where the respective bases are located at essentially the same level, and are positionable in a collapsed state due to the sliding surface and the sliding plate interacting to cause the respective bases to be at different levels, thereby causing the first and second keyswitch to collectively take up less surface area than when in the expanded state,

wherein each keyswitch further comprises a key cap, and a lever assembly, the lever assembly having a top portion connected to a bottom of the key cap and a bottom portion connected to a top of the base; and

at least one membrane circuit provided to connect the first and the second keyswitches and enable the first and the second keyswitches to be arranged in the collapsed state, whereby a separation between the first and the second keyswitches is reduced and the keyboard has a reduced size.

2. The collapsible keyboard as in claim **1**, wherein the lever assembly is of a scissors structure.

* * * * *